"An Apparatus for Facilitating the Connection of Tubulars Using a Top Drive"

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to an apparatus for facilitating the connection of tubulars using a top drive and is more particularly, but not exclusively, intended for facilitating the connection of a section or stand of casing to a string of casing.

Description of the Related Art

In the construction of oil or gas wells it is usually necessary to line the borehole with a string of tubulars known as casing. Because of the length of the casing required, sections or stands of say two sections of casing are progressively added to the string as it is lowered into the well from a drilling platform. In particular, when it is desired to add a section or stand of casing the string is usually restrained from falling into the well by applying the slips of a spider located in the floor of the drilling platform. The new section or stand of casing is then moved from a rack to the well centre above the spider. The threaded pin of the section or stand of casing to be connected is then located over the threaded box of the casing in the well and the connection is made up by rotation therebetween. An elevator is then connected to the top of the new section or stand and the whole casing string lifted slightly to enable the slips of the spider to be released. The whole casing string is then lowered until the top of the section is adjacent the spider whereupon the slips of the spider are re-applied, the elevator disconnected and the process repeated.

It is common practice to use a power tong to torque the connection up to a predetermined torque in order to make the connection. The power tong is located on the platform, either on rails, or hung from a derrick on a chain. However, it has recently been proposed to use a top drive for making such connection. A "top drive" is a top driven rotational system substantially used for drilling purposes, assigned to the drawworks at a higher level than the elevator, as is previously known.

Because of the high costs associated with the construction of oil and gas wells time is critical and it has been observed by the applicants that the time to connect a tubular to a top drive using existing equipment could be reduced.

SUMMARY OF THE INVENTION

Accordingly there is provided an apparatus for facilitating the connection of tubulars using a top drive, which apparatus comprises a body connectable to said top drive, said body comprising at least one gripping element radially displaceable by hydraulic or pneumatic fluid to drivingly engage a tubular to permit a screw connection between said tubular and a further tubular to be tightened to the required torque.

Other features of the invention are set out in Claims 2 to 14. Delete

The present invention also provides an apparatus for facilitating the connection of tubulars using a top drive, said apparatus comprising a body connectable to said top drive, said body comprising at least one gripping element radially displaceable to drivingly engage said tubular and a sealing packer to inhibit, in use, fluid in said tubular from escaping therefrom.

Preferably, said sealing packer can be actuated by hydraulic or pneumatic fluid.

One advantage of at least preferred embodiments of the invention is that the gripping elements transfer the full torque capacity of the top drive to the casing without damaging the pipe surface. Elastomeric jaws greatly reduce the marks made by the dies as compared to simple metal dies. Elastomeric jaws also enable pipes with differing inside diameters to be clamped with only one set of jaws.

The present invention also provides an apparatus for running tubulars into a borehole, said apparatus comprising a body provided with a wedge lock assembly and a hydraulically operable grapple to mechanically grip the inside wall of a tubular to be run into, or withdrawn from, the borehole, said grapple incorporating positive locking means to prevent inadvertent release of said grapple, said body further comprising means to prevent spillage of drilling fluid when the body is withdrawn from the tubular, a sealing packer for engagement with the tubular to permit fluid to be circulated within the tubular, and a stabbing guide.

[Further features of the apparatus for running tubulars into a borehole in accordance with the present invention are set out in Claims 18 to 24.] – Delete

In use, such an apparatus may be connected to a top-drive unit via a threaded connection, or to a kelly driven rig via a pump joint latched into an elevator. Both systems have available a means of connecting up to a circulating system that will permit the casing to be filled or circulated at any time during the running operation.

Casing is normally run by picking up a joint at a time, utilising single pickup elevators to bring the joint into the derrick and connect it to the previously run joint, whether it be by threaded connection or "mechanical latching or locking". The two joints are either screwed or locked together and then lowered into the well bore using elevators.

With heavy casing strings it is required that very large elevators are used to be able to handle the load. This often means that the top of the casing joint must be set 8–10 feet above the rig floor to permit disengagement to take place. Scaffolding is often required for the rig crews to be able to stab or connect the next joint to the string. It is also normal to either utilise a separate pack-off assembly, or a fillup hose that must be installed by the rig crew after it has been lowered and set in the slips.

Preferred embodiments of the present invention will permit the casing to be picked up by single pickup elevators, connected either by rotation or mechanical latch, and then the casing running tool to be "stabbed" into the bore of the top joint without damage, due to the rubber bull-nose guide. When the tool is at the correct depth of penetration within the casing bore, the hydraulic piston is actuated to drive the grapple down onto the wedge lock and secure the grapple to the casing wall. As the casing string is lifted, the wedge-lock continues to drive into the grapple bore, providing an ever increasing wedge lock. The compression spring installed within the hydraulic piston provides a "positive-lock" or failsafe should the hydraulic system fail for any reason.

When the apparatus is engaged, it is then possible to push, pull, or even rotate the casing string. A seal ring assembly is required to rotate the casing string, to permit constant control of the hydraulic actuating piston to be maintained.

Preferred embodiments of the apparatus are equipped with a through-bore to permit casing fillup and circulation to take place at any time. There may also be provided a pack-off that can be either inflatable or flow pressure operated.

The present invention also provides a top drive having an apparatus in accordance with the present invention attached thereto.

BRIEF DESCRIPTION OF THE DRAWINGS

Some preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional side view of a first embodiment of an apparatus in accordance with the present invention inserted in a section of casing;

Figure 2 shows the apparatus of Figure 1 connected to a top drive and inserted in a section of casing;

Figure 3 shows a cross-sectional side view in perspective of part of a second embodiment of an apparatus in accordance with the present invention;

Figure 4 shows a cross-sectional side view of a third embodiment of an apparatus in accordance with the present invention; and

Figure 5 shows a cross-sectional side view of the embodiment of Figure 4 in use.

Referring to Figure 1 there is shown an apparatus which is generally identified by reference numeral 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The apparatus 1 comprises a cylindrical body 2 which has a central passage 3 therethrough. The cylindrical body 2 has circumferentially spaced recesses 4 thereabout in which respective gripping elements 5 are located.

The upper part 6 of the cylindrical body 2 is of a reduced outer diameter. The upper part 6 passes through a rotary transmission 7 and is rotatably supported by two bearings 8, 9 which are arranged in corresponding channels 10, 11 in an annular support 12. A circumferentially raised portion 13 between the two bearings 8, 9 is provided in the upper part 6 to inhibit longitudinal movement of the cylindrical body 2.

The rotary transmission 7 is mounted fast on the annular support 12 and is in sealing tight relation with the upper part 6 which is rotatable relative thereto. The rotary transmission 7 is provided with a feed passage 15 in the annular support 12 and with a feed line 16. The other end of the feed passage 14 is in fluid communication with a radial channel 17. Feed passages 18 are provided in the cylindrical body 2 to link the radial channel 17 with the circumferential recesses 4 behind each gripping element 5.

The upper part 6 is provided with internal splines 19 along the upper part of the passage 3. The lower end of a connecting member 20 is provided with corresponding external splines and is located in the upper part of the passage 3. The upper end of the connecting member 20 is provided with a circulating canal 22 and threads 23 for connection to a top drive (Figure 2).

The support member 12 is provided with two axles 24, 25 to which compensating cylinders 26, 27 are attached, the corresponding pistons 28, 29 being, in use, connected to the body of the top drive (Figure 2).

Gripping elements 5 are preferably based on the construction described in PCT Publication No. WO 94/05894 which is incorporated herein for all purposes, and sold by the applicants under the trade mark "MICRO-GRIP".

The gripping elements 5 comprise a plurality of longitudinally extending strips (not shown) which are embedded side by side in an elastomeric base member (not shown). Each strip projects out from said elastomeric base member, and each strip has a pipe gripping edge (not shown) facing away from the elastomeric base member, so that channels are formed between adjacent strips to accommodate debris from the surface of the casing to be gripped. The pipe gripping edge may, for example, comprise teeth, so that the strips resemble saw blades, or may comprise particulate material bonded to the strips. This type of gripping element allows rotational torque to be applied to the tubular and longitudinal forces produced by circulating fluid within the tubular and the weight of the tubular to be taken.

The cylindrical body 2 is shown in Figure 1 in a section of casing 20 with gripping elements 5 in a radially extended position, engaging the inner wall 31 of the section of casing 30 beneath a threaded box 32.

In use, the pistons 28, 29 are connected to the stator 34 of the top drive 33 (Figure 2). The rotor 35 of the top drive 33 is connected to the connecting member 20. The section of casing 30 is positioned over the upper portion of a casing string using, for example, a pipe positioning device. The top drive 33 with the attached apparatus 1 is lowered so that the cylindrical body 2 thereof enters the casing 30. Alternatively, the section or stand of casing may be brought towards the apparatus 1 using the methods and apparatus disclosed in co-pending UK Patent Application No. 9818366.8 entitled "Methods and Apparatus for Facilitating the Connection of Tubulars Using a Top Drive" filed by the applicant for the present application on 24 August 1998. If the support member 12 hits the top of the threaded box 32, the compensating cylinders 26, 27, which contain compressed air, cushion the impact whilst the splines 19, 21 in the upper part 6 of the cylindrical body 2 will allow relative longitudinal movement between the apparatus 1 and the top drive 33 whilst being able to transmit rotation therebetween.

Hydraulic pressure is applied through feed line 16, feed passage 15, feed passage 14, radial channel 17, and feed passage 18 into recess 4 behind gripping elements 5,

forcing the gripping elements 5 radially outwardly to engage the inner wall 31 of the casing 30.

The top drive 33 may now be used to rotate the rotor 35 which in turn rotates the connecting member 20, the cylindrical body 2 and hence the casing 30. The compensating cylinders 26, 27 will allow a small downward movement as the threaded pin on the bottom of the casing enters the box on the top of the string, and may be controlled remotely. The compensating cylinders 26, 27 may be of the pneumatic compensating type, i.e. their internal pressure may be adjusted to compensate for the weight of the casing 30 so that movement of the tubular may be conducted with minimal force. Pneumatic compensating cylinders also reduce the risk of damage to the threads of the tubulars. This can conveniently be achieved by introducing pneumatic fluid into the cylinders 26, 27 and adjusting the pressure therein. Hydraulic cylinders may, however, be used or hydraulic cylinders provided with a pneumatic bellows system.

Once the joint is correctly tightened the elevator 37 is swung into position and the elevator slips therein (not shown) are actuated to grip the casing 30 beneath the box 32. The top drive 33 is then raised a small amount using the drawworks to enable the slips in the spider to be released and the top drive and casing string is then lowered.

As the casing is lowered liquid may be introduced into the casing 30 via the connecting canal 22 and the central passage 3. The introduction of such liquid is often desirable to facilitate the lowering of the casing.

Referring to Figure 3 there is shown an apparatus in accordance with a second embodiment of the present invention which is generally identified by the reference numeral 101.

The apparatus 101 is generally similar to that of Figure 1, in that it comprises a cylindrical body 102 which has a central passage 103 therethrough. The cylindrical

body 102 has recesses 104 thereabout in which gripping elements 105 are located. The gripping elements 105 are provided with recesses 106.

The cylindrical body 102 is also provided with a cylindrical sealing packer 107 arranged below the gripping elements 105. The cylindrical sealing packer 107 is provided with a recess 108. The cylindrical sealing packer 107 which is made from an elastomeric material is fast with the cylindrical body 102.

The cylindrical body 102 is provided with a feed passage 109 which is at the upper end connected to a hydraulic fluid supply, and at the other, to the recesses 106 and 108 in the gripping elements 105 and the cylindrical sealing packer 107 respectively.

In use, the apparatus 101 is connected to a top drive, such as that shown in Figure 2, and is inserted into the top of a section or stand of casing 110. Hydraulic fluid pressure is applied through feed passage 109 into recesses 106 and 108 which moves the gripping elements 105 into engagement with the inner wall 111 and the cylindrical sealing packer 107 into contact with the inner wall 111. The gripping elements 105 engage with the inner wall 111 of the casing 110 so that rotational force can be transmitted from the apparatus 101 to the casing 110. The sealing packer 107 substantially prevents any fluids such as mud from escaping between the apparatus 101 and the casing 110. This is particularly advantageous where it is desired to circulate fluid to facilitate running the casing. In particular, if the casing string becomes lodged on an obstruction, liquid can be pumped down the casing string under high pressure to remove the obstruction. The sealing packer 107 facilitates this operation by inhibiting liquid under high pressure escaping through the top of the casing 30.

Referring to Figures 4 and 5 there is shown an apparatus in accordance with a third embodiment of the present invention which is generally identified by the reference numeral 201.

The apparatus comprises a cylindrical body 202 with a threaded connection 203 at the upper end for connection to a top drive. Attached to the cylindrical body 202, or machined into it, is a hydraulic cylinder 204, with threaded ports 205, 206 at opposite ends. These ports 205 and 206 permit hydraulic fluid to be injected under pressure to manipulate a hydraulic piston 207, secured within the cylinder by a threaded lock ring 208. A compression spring 209 is located in the cylinder 204 above the piston 207.

A grapple 210, provided with serrated teeth machined into its outer surface, is provided around the cylindrical body 202 below the hydraulic cylinder 204. The grapple 210 is connected to the hydraulic piston 207 by a threaded connection 211. A corresponding wedge lock 212 is provided on the cylindrical body 202. The grapple 210 and corresponding wedge lock 212 are located, in use, inside a casing 213. The piston 207 and lock ring 208 are fitted with seal rings (not shown) to prevent hydraulic fluid leakage.

A mud-check valve 214 is thread connected at the lower end of the wedge lock 212. Below this valve is a rubber pack-off assembly 215. These prevent spillage of drilling fluid when the apparatus 201 is removed from within the casing joint 213. The pack-off 215 can be energised by either internal mud pressure or external mud flow.

In use, the apparatus 201 is lowered into the casing joint 213 as shown in Figure 4. The grapple 210 is held out of contact with the wedge lock 212 by hydraulic fluid injected into port 206.

When the apparatus 201 is located at the correct installation depth within the casing 213, the pressure and fluid is released from port 206, and fluid is injected into port 205. This pushes the piston 207 downwards, pressing the grapple 210 against the wedge lock 212. The grapple 210 is forced outwards by the wedge lock 212, forming a mechanical friction grip against the inner wall of the casing 213. This is shown in Figure 5.

The rig lifting equipment (not shown) raises the apparatus 201, and this causes the wedge lock 212 to be pulled upwards against the inner surface of the grapple 210, ensuring that constant outward pressure is applied to the grapple 210. The grip becomes tighter with increasing pull exerted by the rig lifting equipment.

Should hydraulic pressure be lost from port 205, the compression spring 209 ensures that the piston 207 continues to press the grapple 210 against the wedge lock 212, preventing release of the grapple from the wedge lock.

The apparatus 201 and casing 213 are then lowered into the well bore and the casing is secured. The apparatus 201 is lowered so that it supports its own weight only, and hydraulic fluid is then pumped out of port 205 and into port 206 to release the grapple 210 from the wedge lock 212 and thus release the apparatus 201 from the casing 213. The apparatus is then removed from the casing joint 213 and the process is repeated.

It is envisaged that the apparatus as described above could be used in conjunction with any of the apparatus and used with any of the methods as described in the co-pending International Applications based on GB Application Nos. 9818360.1, 9818363.5 and 9818366.8 entitled "An Apparatus for Facilitating the Connection of Tubulars Using a Top Drive", "Method and Apparatus for Facilitating the Connection of Tubulars using a Top Drive" and "Method and Apparatus for Facilitating the Connection of Tubulars using a Top Drive" respectively.

ABSTRACT

"An Apparatus for Facilitating the Connection of Tubulars Using a Top Drive"

An apparatus for facilitating the connection of tubulars using a top drive, which apparatus comprises a body (2; 102) connectable to said top drive, said body (2; 102) comprising at least one gripping element (5; 105) radially displaceable by hydraulic or pneumatic fluid to drivingly engage said tubular (30; 110) to permit a screw connection between said tubular and a further tubular to be tightened to the required torque.